Biological Evaluation of Southern Pine Beetle (*Dendroctonus frontalis* Zimmermann) in New Jersey State Lands

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Introduction

There are an estimated 440,000 forested acres in southern New Jersey, where pine is the dominant forest cover type. The Southern Pine Beetle's (SPB) natural range is from Pennsylvania to Florida to Illinois and Texas. The SPB attacks all species of pines, but prefers pitch, shortleaf, pond, and loblolly, which all occur in southern NJ. Initial SPB damage appears as crown fade--yellow progressing to red and eventually brown, usually within 1 to 2 months. Since 2001, the southern pine beetle (SPB) has affected 32, 000 acres of these southern NJ forests –7 percent of the total pine acreage. Eighty-percent of the pine acreage killed has been lost since 2010. New Jersey pine mortality appears as classic SPB-caused mortality; dense pine forests with spot infestations. There appears to be no significant influence from associated tree mortality or unusual predisposing agents. Although the numerical presence of *Thanasimus dubius* (a predator of SPB) is high, their impact in NJ has not been studied. There are significant community impacts and a Wildland Urban interface (WUI) fire implications associated with this outbreak as well. The pinelands region is historically a fire-rich ecosystem, and the interspersion of human development is central to forest pest management tactics developed for the region.

The Pinelands was the first National Reserve in the United States. The Pinelands Reserve covers over 1.1 million acres. It is the largest open space on the Mid-Atlantic seaboard and is underlain by aquifers containing 17 trillion gallons of water. In 1983 the area was designated as a US Biosphere Reserve and in 1988 it was recognized as an International Biosphere Reserve. The Pinelands consist of pine and oak, cedar and hardwood swamps and pitch pine lowlands. Within the Pinelands there is also 12,000 acres of Pineland Plains formerly called “pygmy forest”. The Pineland Plains is a unique stand of dwarf pine and oak that are less than 11 feet tall when mature. Ownership of the Pinelands is 33% public and 67% private. Federal property within the Pinelands consists of the Forsythe NWR and the Cape May NWR as well as Fort Dix (Army), Lakehurst Naval Air Base and McGuire AFB. The Pinelands consists of wildland-urban interface at multiple spatial scales. There are the typical yard trees, recreation areas, etc. but also extensive forests (hundreds of acres) interspersed with suburban and urban environments. Needles falling from pines can land on understory vegetation, creating a fuel ladder effect, which facilitates wildfires reaching the tree crowns. Trees with intact, dead needles can promote crown fires.

The SPB has now entered the globally rare plant communities of the Pinelands Reserve. The Pinelands infestation will likely continue to spread rapidly–initial estimates of the potential expansion for 2012 range from 5,000 to 40,000 acres, and about 400,000 acres are at risk due to their species composition, age and stand density. Thirty-percent of the impacted lands in New Jersey are under the administration of the NJ Department of Environmental Protection (DEP). Suppression efforts in NJ will be focused on DEP lands. Ongoing outreach efforts are focused on encouraging private landowners to also conduct suppression, mitigation or reforestation activities. In 2011 NJ submitted a proposal titled “An integrated approach to southern pine beetle control and mitigation in the Pinelands region” to the NA competitive allocation RFP to begin addressing this issue.

Without SPB mitigation activities, NJ can expect a significant increase in affected acres in 2012 and 2013 due to the large existing population and likely low winter mortality. Temperatures around 0 degrees (F) for several consecutive days are needed to cause mortality of pupae or adult beetles. Temperatures around 20 degrees (F) for several consecutive days are effective for killing egg and larval stage SPB.

The current infestation is so large and complicated by ownership and policy dilemmas that suppression activities must be prioritized. An important issue for the timeliness of forest management activities (such as thinning, salvage tree removal, etc.) is the permitting process that has been developed to help conserve the Pinelands resources. Time for analysis/ documentation/communication/review and approval must be considered in the development of any forest management scenario.

With respect to individual homeowners, there is a need to determine whether or not there exists an effective product for protection of individual trees and whether the use of such products is appropriate. Estimates of product effectiveness are available, including those products that are available for homeowner use. Either the US Forest Service or NJ DEP should be contacted with questions regarding available treatments and their efficacy.

In 2003, the USDA Forest Service and the Southern Group of State Foresters initiated a proactive Southern Pine Beetle (SPB) Prevention and Restoration Program. Restoration activities are designed to return damaged areas to healthy forest conditions and to create stands that are less susceptible to future SPB infestation. The program primarily focuses on reducing the pine density of stands; cost share programs are available through the NJ DEP.

Brief history, including past suppression efforts

An outbreak of SPB in southern NJ was noted in 1939, but there was not another in the Garden State until fall of 2001. It is theorized that drought and above average temperatures in the region during the late 1990's, in the Mid-Atlantic region have contributed to SPB's recurrence in New Jersey. Once infestations are established, the forest environment in NJ is highly suitable for continued SPB spot proliferation and growth.

Since 2001, SPB has infested over 26,000 acres of mixed pine forests in southern New Jersey. During the 2010 season, SPB infested over 14,100 new acres and in 2012, 6,261 acres. Infestations are occurring on state and private property from Cape May to Monmouth Counties (9 counties), ranging in size from less than one acre to over 800 hundred acres. County and municipal lands have also been impacted by SPB and continue to be at risk. Protection efforts will concentrate on the Pinelands forest resource area.

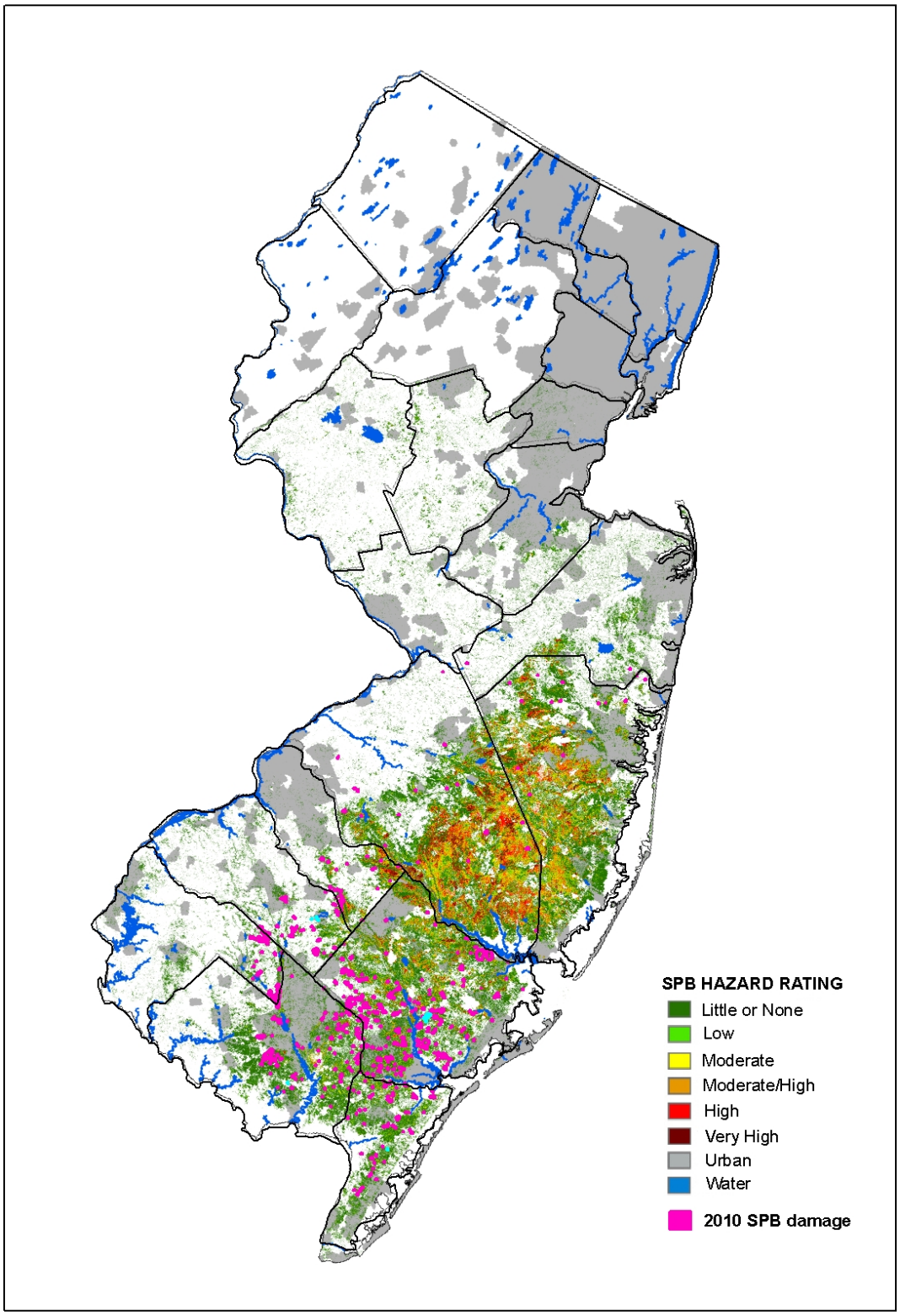


Figure 1. Risk map of the pine barrens.

SPB Acres

Year	Acres
2008	4000
2009	1210
2010	14100
2011	6789
2012	6261

Trap data

Year	Total SPB	Total Clerids	SPB / Day	Clerids / Day	% SPB	% Clerid
2008	1236	1654	9.3	12.4	43%	67%
2009	1200	3535	9.2	27.1	25%	75%
2010*	3805	3436	32.5	29.3	53%	47%
2011**	5371	12499	51.1	118.8	30%	70%
2012	3511	4727	30.2	36.8	45%	65%

* In 2010 traps were active for 5 weeks

** In 2011 the trapping period was 27 weeks but only the first 6 weeks are included here

Current situation

The ratio of green infested trees to red infested trees is important for projecting the rate and extent of SPB spot expansion. The number of SPB spots predicted to have additional timber loss, and the size of the losses, were used to project whether SPB damage will escalate, remain static, or decline in the future. A large number of SPB spots can be relatively unimportant if projected per spot losses are small. Conversely, a few rapidly expanding SPB spots can cause large timber losses. During April, May and June of 2012, the authors examined 10 SPB infestations in New Jersey. Observations were noted at each regarding the following factors: the number of freshly attacked trees; spot growth; and spot growth potential based on surrounding uninfested stand conditions.

Spot Growth Ratio

Date	Name	Green	Red	Vacated	Total Affected	G:R	Age of trees	BA / Pine	dbh	height
04/17/12	Forsythe	3	2	15	20	1.50	45	14	10	50
04/17/12	Harding 1	8	17	300	325	0.47	40	11	13	50
04/17/12	Harding 2	1	23	2	26	0.04	57	14	12	45
04/17/12	Clarks Landing	2	13	61	76	0.15	82	11	14	50
04/19/12	Union Lake 1	5	21	24	50	0.24	60	12	11	45
04/19/12	Union Lake 2	8	5	2	15	1.60	71	8	15	55
04/19/12	Union Lake 3	4	9	18	31	0.44	70	13	12	55
04/19/12	Union Lake 4	0	11	19	30	0.00	64	6	10	40
05/16/12	Clarks Landing	42	13	61	116	3.23	82	11	14	50
06/06/12	Harding 2	28	12	300	340	2.33	57	14	12	45
06/06/12	Clarks Landing	50	13	61	124	3.85	82	11	14	50
06/07/12	Wawa	87	49	65	201	1.78	48	8	10	50
06/07/12	Bass River 1	2	0	2	4	#DIV/0!	61	9	8	55

The NJ Forest Service monitors SPB population number and distribution by setting out specialized traps in strategic forest locations. Traps are designed to resemble the bole of a tree and are placed in forested areas where pine is not present or represents a small component of the forest type. This method reduces the chance of spreading the SPB to areas not previously invested.

The SPB are drawn to the traps by attractive lures that consist of turpentine and a pheromone (frontalin). Flying SPB sense the attractants and follow the scent back to the source trap. The SPB then land on the trap (above) and eventually fall down the center and into a solution that preserves them for identification. Other beetles, such as the predatory checkered beetle, may also be attracted and caught, thereby also indicating their presence.

Foresters collect, identify, and count the beetles in the traps; the number of SPB and checkered beetles captured are used to develop a ratio which is used for predicting SPB population category. SPB populations are categorized as extreme, high, moderate, static or declining, and suppression activities

can then be planned accordingly. The population trend predictions assist the NJ Forest Service in determining how and where to best utilize their suppression resources.

Woodpeckers eat SPB and their stripping of outer bark can help indicate infested trees. They strip away the bark to prey on SPB, creating light colored, slick boles with piles of bark at their base. Woodpeckers are predacious on all life stages of the SPB, but prefer pupae and adults because they are easier to find and excavate. While the trees targeted by woodpeckers for foraging on SPB will die, the number of SPB's remaining to infest other trees is reduced.

For aerial surveys, Digital Aerial Sketchmapping (DASM) is used in conjunction with traditional aerial photographic interpretation to locate and map existing damage and help to predict potential spread or decline. GPS equipment is linked to a laptop computer inside the aircraft. Geographical Information Systems (GIS) software is installed on the computer, and when linked to the GPS unit shows ground features in relation to the aircraft. The aerial observer marks the areas that show signs of SPB damage, usually the faded crowns of pine trees, using the touchscreen. These waypoints are downloaded to handheld units for data assimilation and terrestrial evaluation.

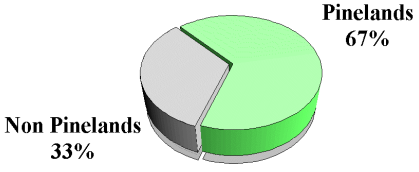
Recent Acres Infested

A total of 25 acres at 34 sites on 9 parcels have been treated using the cut-and-leave method. We are currently monitoring about 1,500 active sites, which range in size from 0.1 to 46 acres. Data analysis from the current mid-summer aerial survey flight is about half complete. So far, we have seen an increased level of activity, in general, and expect our active acreage to be in excess of 7,000 acres. There are 540 polygons with a maximum size of 34 acres and a mean of 3.6 acres.

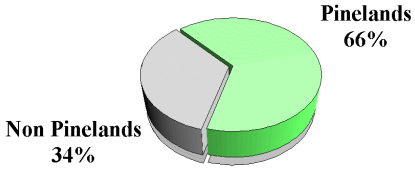
Aerial Monitoring Program
2012 Potential SPB Infestation
Update 1/12 – 7/12

Active Infestations	Acres
In Pinelands	2,145
Outside of Pinelands	1,089
Total Active Infestations	3,234
State Lands in Pinelands	559
State Lands outside of Pinelands	270
Total State Lands	829

Overall SPB



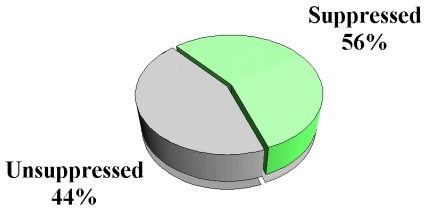
SPB on State Lands



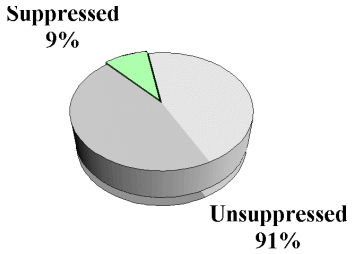
2012 COMPLETED SPB SUPPRESSION ON STATE LANDS

Location	Suppression Type	Suppressor	Area	Costs
Pinelands				
	Cut-and-Leave (CL)		32.9	$37,258
		SFS	32.9	$37,258
		Contractor	0.0	$0
	Cut-and-Remove (CR)		22.7	$6,900
		SFS	0.0	$0
		Contractor	22.7	$6,900
	Total (CL and CR)		55.6	$44,158
Out of Pinelands				
	Cut-and-Leave (CL)		12.2	$10,430
		SFS	12.2	$10,430
		Contractor	0.0	$0
	Cut-and-Remove (CR)		138.1	$45,958
		SFS	3.6	$2,208
		Contractor	134.5	$43,750
	Total (CL and CR)		150.3	$56,388
All areas (in and out of Pinelands)			205.9	$100,546

Suppression Outside Pinelands



Suppression Inside Pinelands



Recommendations

FHP anticipates that data analysis will show a continued loss of timber in NJ due to SPB in FY 2012, and recommends funding of a SPB suppression project in New Jersey. The probability of increasing SPB activity in NJ is high and the consequent impacts on NJ pine forests are substantial. The cut and remove treatment (Alternative 2) is the preferred method for control of SPB spots. In NJ, however, this option is not usually available so managers must primarily rely on cut and leave. Cut and hand spray, and pile and burn are considered effective treatments but they are more expensive and may not be otherwise suitable due to their reliance on fire or synthetic insecticides.

Alternatives for SPB Control (No action, Cut and remove, Cut and hand spray, Cut and leave, Pile and burn)

Natural environmental factors--such as diseases, parasites, predators and weather--may help maintain beetle populations at endemic levels and perhaps bring outbreaks under control. Integrated pest management may be achieved through any one or all of the following suppression techniques: rapid salvage and utilization of infested trees, piling and burning of infested materials, chemical control in high value resources, and cut-and-leave (May through October). The methods depend on many factors, including the severity of infestation, damage, and timber markets. Good forest management is the most effective method for preventing or mitigating losses from the southern pine beetle. Cut and Leave (Directional Felling) can be effective in disrupting the growth of individual spots.